

Partnered Disaster Preparedness: Lessons Learned From International Events

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Abstract

Military, governmental, and civilian agencies routinely respond to disasters around the world, including large-scale mass casualty events such as the earthquake in Pakistan in 2005, Hurricane Katrina in the United States in 2005, and the earthquake in Haiti in 2010. Potential exists for improved coordination of medical response between civilian and military sectors and for the creation of a planned and practiced interface. Disaster preparedness could be enhanced with more robust disaster education for civilian responders; creation of a database of precertified, precertified medical specialists; implementation of a communication bridge; and the establishment of agreements between military and civilian medical/surgical groups in advance of major catastrophic events.

The United States armed forces routinely respond to disasters worldwide. The devastation caused by large-scale mass casualty events such as Hurricane Katrina in New Orleans in 2005¹ and the earthquake in Haiti in 2010² requires a shared response by civilian and governmental agencies. Advance preparation and organization is essential to coordinate the multiple support systems required for a response effort that provides essentials such as food, water, shelter, medical care, sanitation, and safety. Preparations include real-time development of a command-and-control structure, effective planning that keeps ahead of the unfolding disaster, logistical and transportation support, and security for both the persons affected and the responders.

Pakistan Earthquake

On October 8, 2005, an earthquake of 7.6 magnitude struck Pakistan in

the Himalayan Mountains north of Islamabad.³ The United States' contribution to the international effort, Operation Lifeline, eventually included more than 1,900 military personnel from 35 different commands within the Army, Navy, Air Force, and Marine Corps.

Assets deployed included two field hospitals that were convoyed over devastated roadways from their arrival point to the quake zone (Figure 1). The responders included general, orthopaedic, and obstetrics-gynecologic surgeons, as well as emergency medicine and family physicians, pediatricians, nurses, technicians, and support personnel. Forty thousand patients were treated, and nearly 500 surgeries were performed during 5 months in country. One field hospital was donated to the Pakistan military to allow continued care in the region on completion of the mission.⁴

Good cooperation was achieved between the military, the multiple re-

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14. ABSTRACT Military, governmental, and civilian agencies routinely respond to disasters around the world, including large-scale mass casualty events such as the earthquake in Pakistan in 2005, Hurricane Katrina in the United States in 2005, and the earthquake in Haiti in 2010. Potential exists for improved coordination of medical response between civilian and military sectors and for the creation of a planned and practiced interface. Disaster preparedness could be enhanced with more robust disaster education for civilian responders; creation of a database of precredentialed, precertified medical specialists; implementation of a communication bridge; and the establishment of agreements between military and civilian medical/surgical groups in advance of major catastrophic events.					
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relief agencies, and nongovernmental organizations, which enabled resource sharing and patient transfer within the region based on the capabilities of each organization. These efforts were well orchestrated through United Nations cluster meetings, which were held frequently to assess the status on meeting basic needs such as food; shelter; water, sanitation, and hygiene; refugee camp monitoring; and medical care. Cooperation between civilian and military organizations was surprisingly good, considering the diversity of countries that responded and the logistical and language barriers. Challenges included performing the military aspects of the operation in a potentially hostile area and the effect of the overwhelming response on local facilities vis-à-vis movement of material and hub airport capabilities. In addition, US military medical units were not configured for humanitarian/disaster response missions, so adjustments were made as needed. Operation Lifeline was successful as measured by the number of lives that were positively affected through the provision of medical care and relief supplies.

Global force airlift positioning capability is a key strength of the US military. The potential for this capability to enhance peace worldwide by providing humanitarian aid and support to disaster efforts relief is increasingly recognized.

Hurricane Katrina

On August 29, 2005, Hurricane Katrina came ashore along the Loui-

Figure 1



Photograph of soldiers in the 212th mobile army surgical hospital unit setting up a tent to be used as the intensive care unit of a field hospital in Pakistan following the earthquake in October 2005.

siana and Mississippi Gulf Coast, causing extensive flooding and displacing thousands of people.¹ The hurricane made landfall at Grand Isle, LA, with wind speeds of approximately 140 mph. The magnitude of the devastation overwhelmed available local, city, and state emergency services, resulting in state requests for federal emergency assistance. Disaster response was provided by organizations such as the Federal Emergency Management Agency, state and local government agencies, US National Guard, US Coast Guard, and National Inter-agency Fire Center.

Active-duty military personnel

from all services were called into action at levels far exceeding those required for any previous natural disaster. US Department of Defense (DoD) teams were rapidly deployed throughout the Gulf Coast region. An Air Force Expeditionary Medical Support unit was stationed at New Orleans International Airport. In fewer than 6 days, the Air Force, in concert with federal, state, and local emergency responders, had coordinated >2,500 aircraft flights, moved >28,000 displaced persons, and aeromedically evacuated >2,600 patients.⁵ This was facilitated by three factors: well-coordinated aeromedical evacuation and Air Force critical

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care air transport teams; the variety of types of aircraft capable of performing aeromedical evacuation missions; and centralized, worldwide aircraft and aircrew control. The USS Iwo Jima, an amphibious assault helicopter carrier, was moored at New Orleans and provided communication and logistical support while requiring no assets (eg, electricity, water, food, berthing) beyond those contained within the ship.

A complex set of logistical and planning inadequacies existed at the local large medical centers. The flood and the power outages isolated the facilities, which allowed for little command and control as the situation progressed as well as limited contact with the massive relief effort surrounding them. Two hardwired land lines and a battery-powered light served as the command post for Tulane University Hospital. Communication between Charity Hospital and Tulane University Hospital, which were located directly across the street from each other, was essentially limited to rooftop-to-rooftop hailing. Virtually no communication existed between the government and/or military responders for several days.

Tower destruction, insufficient bandwidth, and lack of power for charging rendered cellular telephones, satellite phones, and ham radios marginally functional. Limited commonality existed in communication systems between the hospitals, emergency medical services responders, police, and military. Lack of systems interface is a recurrent problem in disaster response. Other considerations that do not become manifest until a disaster strikes include security, storage, and lack of a plan for managing spontaneous unaffiliated volunteers who show up with no credentials. Provision of food, water, and sanitation; medical record keeping; and patient evacuation were

challenging following the storm.

Understanding which systems will or will not be supported by backup generators in the event of a power failure is critical in disaster preparedness planning. These systems might include communication, heating and air conditioning, refrigeration, electronic medical records, radiology, and pharmaceutical supply, all of which complement the basics of medical care and life support. Following an event such as Hurricane Katrina, an extensive after-action review is mandatory to identify fundamental flaws in the system response plan. Hazard Vulnerability Analysis documents also should be reevaluated. Following Katrina, several key changes were implemented at the public hospitals (ie, Charity Hospital system) and in one of the private systems (ie, Hospital Corporation of America) in advance of Hurricane Gustav in September 2008.⁶ Good communication and aggressive movement of patients and resources made for successful disaster management in these 20 facilities, resulting in a much more organized and orderly response than was seen after Hurricane Katrina. The Federal Emergency Management Agency system was still lacking with regard to organization and coordination of patient movement.

Haiti

The United States responded within hours of the earthquake of 7.0 magnitude that struck Haiti on January 12, 2010, following a request from the Government of Haiti.⁷ The secretary of defense, under the authority of the president, initiated relief efforts in coordination with the Office of Disaster Assistance and the Department of State. US governmental efforts were coordinated through and integrated with the United Na-

tions. Within 24 hours, the Department of Health and Human Services National Disaster Medical System mobilized the three International Medical-Surgical Response Teams (IMSuRTs) (East, West, South) in addition to at least five US Disaster Medical Assistance Teams. These were made up of civilian volunteer physicians, nurses, emergency medical technicians, pharmacists, and other medical specialists. The 50 Disaster Medical Assistance Teams stationed around the United States typically provide emergency medical assistance nationally; however, they deployed to Haiti because of the extraordinary number of casualties and the destruction of the medical infrastructure in the region of the capital.

The IMSuRTs have surgical capability and are designed to be rapidly deployed overseas. In 2003, IMSuRT-East was deployed to Bam, Iran, following the earthquake there.⁸ IMSuRTs are deployed within the United States, as they were following Hurricane Katrina. These civilian volunteer teams arrived within 72 hours of the earthquake in Haiti to set up field hospitals with surgical capabilities in Port-au-Prince. Security concerns caused initial delays. With the assistance of the US State Department and a complement of the 82nd Airborne Division, the main IMSuRT established the Haitian Group for the Study of Kaposi's Sarcoma and Opportunistic Infections (GHESKIO) Field Hospital at Quisqueya University in Port-au-Prince and began delivering medical and surgical care on January 19, 2010⁹ (Figure 2).

US Navy, Air Force, and Army units responded quickly to the Port-au-Prince area. The Navy initially sent five ships—USS *Bataan*, USS *Fort McHenry*, USS *Gunston Hall*, USS *Carl Vinson*, USNS *Comfort*—along with Seabee and other engineering units. In all, more than 30 ships from

the Navy, Coast Guard, Military Sealift Command, and Maritime Administration responded. These vessels served as platforms for helicopters, received casualties for treatment, and produced a significant amount of fresh water. More than 300 centers were established to distribute several million meals and bottles of water and tons of medical supplies. At the time of the earthquake, USNS *Comfort* was moored in Baltimore, Maryland, and undergoing maintenance. Preparations to render humanitarian assistance to those affected by the earthquake commenced immediately. The maintenance staff of navy medical personnel and civil service mariners was soon augmented with a large complement of doctors, nurses, hospital corpsmen, and administrators from Navy hospitals on the east coast. All reported on board within 48 hours of notification. Medical equipment was calibrated and brought to full operational status to include steam sterilizers, oxygen generation systems, and laboratory and radiology units. Six hundred pallets of food and medical supplies were delivered to the pier and hoisted aboard. USNS *Comfort* departed for Haiti at the 76.5-hour mark—a record for a hospital ship. As the ship steamed south, Navy Medicine flew an augmentation team of 225 additional medical personnel to Guantanamo Bay, Cuba. This group, which included orthopaedic subspecialists, neurosurgeons, and intensive care nurses, transferred by helicopter to USNS *Comfort* once she arrived in Haitian waters.

On January 19, 1 week after the earthquake, as *Comfort* first reached helicopter range of Port-au-Prince, the first earthquake casualties arrived by air. Once anchored, *Comfort* averaged one new inbound patient every 9 minutes. Within 5 days of arrival, the 40-bed intensive care unit and 450 ward beds aboard *Comfort* were filled. Most patients presented with long bone fractures

Figure 2



Traction application for casting at the International Medical-Surgical Response Team Group for the Study of Kaposi's Sarcoma and Opportunistic Infections Field Hospital, Port-au-Prince, Haiti.

Figure 3



Photograph of a patient aboard the USNS *Comfort*. He is in traction and awaiting surgery to manage a femoral fracture 3 weeks after the January 2010 earthquake in Haiti.

and crush injuries, many of which were open and infected (Figure 3). Numerous nongovernmental organizations responded to the unprecedented clinical need aboard *Comfort*

by providing dozens of volunteer orthopaedic trauma surgeons, intensive care nurses, and other clinical professionals. This effort built on previous experiences in humanitarian assis-

tance operations. The teamwork between military and civilian providers under extremely trying circumstances validated the concept of co-operation between military and civilian sectors to benefit disaster victims.

The surgical teams aboard *Comfort* worked hard to prioritize and care for these patients, providing the highest level of surgical care possible in the entire region. Two and a half weeks after the earthquake, >50 persons affected required management of femoral fracture. Many persons with pelvic and acetabular fractures with dislocated hips had arrived without traction. Several patients with complex wounds required multiple procedures to prevent sepsis and preserve limbs. Several eventually required amputation as a life-saving measure. When possible, limb salvage was performed with thorough débridement, bone shortening when necessary, and wound healing by secondary intention. Local flaps were performed, but limited resources precluded the use of free flaps. At 3 weeks, many fractures required take-down of extensive scar tissue and callus to obtain adequate reduction.

The navy surgical team initially worked with a single C-arm and a limited supply of orthopaedic implants. Through the work of the developing supply chain as well as the efforts of industry, equipment resupply and upgrades enhanced the capability to provide care. Civilian orthopaedic trauma surgeons came aboard to augment navy surgeons and to lend their expertise in managing complex injuries. Some of these surgeons initially traveled to Haiti with other aid agencies and worked onshore. They came aboard when it became evident to those on the ground that the surgeons could do more on the hospital ship than in the heavily

compromised land-based medical facilities. The Orthopaedic Trauma Association negotiated with the navy to provide their expertise, and a team of eight senior surgeons arrived 3.5 weeks after the disaster. That initial team cleared the backlog of cases in <2 weeks. The team of three surgeons that followed treated additional incoming cases. After providing care to thousands of patients and completing several hundred major surgical procedures, *Comfort* departed Haiti on March 9, 2010, and returned to Baltimore.

Summary

In the past decade, the US government has shown an ability to respond to mass casualty events. A review of recent disasters, both in-country and offshore, demonstrates that the potential exists for improved coordination of medical response activities between the civilian and military sectors. DoD is able to organize rapidly and provide extraordinary personnel resources, logistics, transportation, and security solutions. However, for greatest effectiveness following a major catastrophic event, a planned and practiced interface with civilian responders should quickly fall into place. Areas for future consideration include more robust disaster education for civilian responders and maintenance of a database of precertified and precertified medical specialists who can be called on in the event of a disaster. The development of a nonmilitary support liaison within the DoD would help to facilitate cooperation and bridge communication between both sides. Agreements between the military and civilian medical/surgical specialty groups should be in place prior to disasters. These agreements would be activated when additional

civilian personnel are required to manage the medical component of a response.

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